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AUTHOR Rubin, Andee; Bruce, Bertram
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ABSTRACT

QUILL, a set of microcomputer-based writing activities for students in grades two through twelve, is based on the recent research on the composing process. To help students become more experienced writers, QUILL includes two tools for writing: a planner, which helps students plan and organize their pieces, and a writer's assistant or text editor, which facilitates the revision process by making the addition, deletion, and rearrangement of text easier. QUILL also provides students with two contexts for writing. The first is an electronic mail system with which students can send messages to individuals, to groups, or to an electronic bulletin board. The second is an information management system in which writing is accessed by title, author, or keyboards. Observations from more than 150 classrooms showed children could use QUILL for genuine communicative purposes if they were provided with the right opportunities. However, QUILL's effectiveness depended on the attitudes teachers conveyed to their students about it, and on the teachers' decisions about how students were allowed to use it. (Included are six lessons on how best to use QUILL that were created during two years of field-testing in second through eighth grade classrooms.) (HOD)

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CENTER FOR THE STUDY OF READING

Reading Education Report No. 60

LEARNING WITH QUILL: LESSONS FOR STUDENTS, TEACHERS AND SOFTWARE DESIGNERS

Andee Rubin
Bertram Bruce
Bolt Beranek and Newman, Inc.

December 1985

University of Illinois
at Urbana-Champaign
51 Gerty Drive
Champaign, Illinois 61820

Bolt Beranek and Newman, Inc.
10 Moulton Street
Cambridge, Massachusetts 02238

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Abstract

QUILL, a set of microcomputer based writing activities for students in grades 2 through 12, is based on the best recent research on the composing process. It includes a word processor, a planner, a library, and electronic mail. Observations from more than 150 classrooms show children can use QUILL for genuine communicative purposes if they are provided with the right opportunities. However, QUILL's effectiveness depends on the attitudes teachers convey to their students about it, and on teachers' decisions about how students are allowed to use it. This paper recounts several lessons, gleaned from the observations, about how best to use QUILL, and educational software in general.

Learning With QUILL:

Lessons for Students, Teachers and Software Designers

She sat silently in the back of the room. Every line in her scowling face demanded, "Show me! Show me how this computer stuff is going to teach my kids how to write!" At the end of the three-day training session on QUILL, a set of microcomputer-based writing activities, we were sure that this was one fourth-grade teacher who would never become a successful user. Soon, however, reports started to filter back about a teacher everyone was calling "Mrs. QUILL." It was our scowling resister. By the end of the school year, her class had written letters to their local congressman and to President Reagan, had organized a "Face the Students" session with their congressman, and had travelled to Washington, where they met with Maureen Reagan. The initial letters, lists of questions for the "Face the Students" session, and thank you letters to the Reagans were all written using QUILL. The project was aided by a local parent who knew the congressman and was impressed by his child's school activities. Several local newspapers carried accounts of the class's letter-writing activities and journey to Washington.

Many people learned important lessons from this teacher's experience. She herself learned that computers could enhance her classroom, even in the unlikely area of writing. The students in her class learned that writing could be used to accomplish goals

they cared about, even in the unlikely place called school. We as software designers learned that even a skeptical teacher would use QUILL in educationally exciting ways, if QUILL were consistent with her educational goals and techniques. In this case, the teacher had always valued letter-writing as a language arts activity. She ran a well-organized, yet flexible classroom into which it was possible to integrate the use of a computer. Using QUILL and the microcomputer, she was able to establish a new and meaningful context for developing literacy in her classroom.

This paper discusses the effects QUILL has had on classroom contexts for communication and literacy. But more generally, it describes changes that an open-ended innovation (one which provides a tool for teachers to create their own educational activities) can bring about for teachers and students. Flexible educational tools require teachers to participate actively in setting directions for their use. Thus, individual teachers may choose different activities, and students may use the tools in significantly different ways. Given this freedom, teachers often create educational activities the developers never considered.

The computer is an interesting medium for investigating these concepts because it is often thought of as an instrument for controlling students and classrooms. We hear about "teacher-proof" software, control of learning, and other features that essentially keep the educational process closed to student and

teacher decision-making. In contrast, open-ended software such as QUILL is "teacher-dependent" and provides a context in which students can work at their own rate, but only if teachers provide that opportunity (Bruce, 1985; Levin, 1982; Rubin, 1982; Collins, in press).

Our contention is that open-ended software--like other flexible educational contexts--provides opportunities for learning which go beyond transferring knowledge from the machine to the student. We discuss below several lessons that teachers, students and software designers learned during the past two years of working with QUILL. They span traditional lessons in language arts, lessons about the writing process, lessons about classroom organization and philosophical lessons about the interaction of purpose and tools in writing. These lessons provide evidence for the educational value of using software that can provide varied opportunities for learning.

What is QUILL?

QUILL (Collins, Bruce, & Rubin, 1982; Rubin, Bruce, & the QUILL Project, in press; Bruce & Rubin, 1984) is a set of micro-computer based writing activities for students in grades 2 through 12. The software design is based on recent research in composition and encompasses the prewriting, composing, revising and publishing aspects of the writing process (Bruce, Collins, Rubin, & Gentner, 1982; Flower & Hayes, 1981; Graves, 1982; Newkirk & Atwell, 1982). To aid students in becoming more

experienced writers, QUILL includes two tools for writing: PLANNER, which helps students plan and organize their pieces, and Writer's Assistant (Levin, Boruta, & Vasconcellos, 1982), a text editor which facilitates the revision process by making the addition, deletion and rearrangement of text easier. QUILL also provides students with two contexts for writing, designed to foster communication by providing audiences for student composition. The first, MAILBAG, is an electronic mail system with which students can send messages to individuals, to groups, or to an electronic bulletin board. The second, LIBRARY, is an information management system in which writing is accessed by title, author, or keywords.

QUILL was used in more than 150 classrooms from Massachusetts to Alaska during the period 1982-1984 (Barnhardt, 1984). These sites provide the basis for the examples used here. For each example, we state a lesson we have learned followed by supporting observations drawn from various classrooms.

Lessons for Students

Student Lesson #1: It is possible to create an environment in school in which legitimate writing occurs.

Students often find the purpose of writing in school to be mystifying. An assignment may involve half an hour of sitting alone, writing about a topic which is boring (e.g., compare Hamlet and Huckleberry Finn) or silly (e.g., describe how it would feel to be an ice cream cone). Typically, everyone must write on the

same topic, and the teacher who assigned the topic is then expected to read and evaluate themes on a subject which is not meaningful to her. The final indignity is that most of the teachers' responses to the writing tend to focus on grammatical or mechanical errors rather than on content.

Students in several QUILL classrooms realized--some for the first time--that writing could be different from this dreary picture. In most cases, this came about through teachers consciously setting up a communicative environment where the audience and purpose for writing were both specific and real. QUILL contributed by providing examples of such contexts and by being an easily-adaptable tool around which to build communicative events. The examples below illustrate these contexts.

On a trip through Alaska to visit QUILL classrooms, we carried a disk called "Supermail." Students in each classroom wrote messages to children in classrooms they knew we would later visit. Students in other classrooms then read these messages, gaining ideas for messages of their own. Some even set for themselves the task of outdoing their peers. Thus, writing became meaningful as a form of communication, sometimes even as competition for readers from an audience of their peers. One example of this "competition from afar" began with the following piece, written by two eighth graders in McGrath, Alaska (population: 500, accessible only by river or air).

CALLING ALL MEN

Sheila Forsythe Althea Jones

Hi

This note is to all you good looking guys out there in the world. There are two of us writing so we'll tell you a little bit about ourselves. Our names are Sheila Forsythe and Althea Jones. We're both 14 and stuck in a small town in Alaska called McGrath. We have a pretty big problem and we hope that you guys will help us out. We have a very short supply of foxy dudes here. So if you are a total fine babe PLEASE I repeat PLEASE write us!!!!

Write:

Sheila Forsythe and Althea Jones
General Delivery
McGrath, Alaska 99627

and hurry!

Keywords: /Mcgrath/Male Order Men/

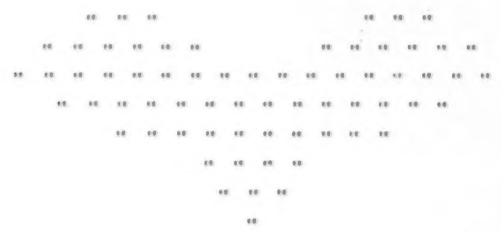
The two authors acknowledge that it was important to call attention to their letter by their choice of keywords. The first keyword--McGrath--was an obligatory identification of the source of the message. But the second (including the misspelling) was their own invention. Since the Supermail disk was actually a Library disk, students chose which entries to read by scanning the list of keywords. These girls were correct in their assessment of their audience: groups of boys in distant

classrooms did choose their message. Not to be outdone, two girls in the next town, Holy Cross, wrote the following message on the Supermail disk:

GOOD LOOKING JUNEAU BOYS

Two Holy Cross Girls Josie and Evelyn

Our names are Josie Adams and Evelyn Fields. We like skiing, basketball, hockey, writing letters to cute boys, and we would be more than pleased if any of you cute boys would write to us. We don't have any boyfriends. So you don't have worry about that! We also would like you to send a picture when you write. (you are going to write aren't you?) We will send you a picture too. Josie is 14, and Evelyn is 13. Well, please write soon! We are waiting for your letters!!!!



WE SEND YOU OUR HEARTS!

SINCERELY, JOSIE AND EVELYN.

Keywords: /Juneau Boys/H.c.r. Girls/

These two girls used a slightly different strategy for attracting readers; they knew the disk would be traveling to Juneau next, so they specifically aimed their "personal ad"

toward Juneau boys, including them in both the title and keywords. They also spent considerable time and effort drawing the heart (an idea they appropriated from the younger students in the school who had spent the morning making word pictures with QUILL) so their message would compete effectively with the one from McGrath. Incidentally, boys in both Juneau and Oregon, where the disk later traveled, took all four girls' addresses with the intention of writing to them during the summer.

Some students discover that writing can be meaningful for self-expression as well as for communication. This was evident in a poignant episode concerning Peter, a sixth-grader in an inner-city school. Peter's home situation was troubled and he didn't do very well in school. In January he ran away and spent several nights sleeping in an abandoned car. After a few days, he reappeared in his classroom and asked if he could use the computer. When the teacher told him he would have to wait his turn, he offered to use the computer in the morning before classes began. One of the first drafts he wrote after returning to school was the following:

PETER'S ISLAND

PETER

HI SWEET POLLY LOVERS...HERE IS A REVIEW OF T.V. SHOW..."PETER'S ISLAND."

ONE DAY THERE WAS A BOY NAMED PETER. HE WANTED TO RUN

AWAY BECAUSE EVERY BODY DID NOT LIKE HIM SO HE RAN AWAY HE HEARD OF A BOAT GOING OUT TO SEA SO HE WENT TO GET ON THE BOAT AND ON THE SECOND DAY AT SEA THERE WAS A BAD STORM AND HE WOKEUP HE WAS IN THE SEA LAYING ON A BOARD AND HE WAS GETTING TIRED AND HUNGRY SO WENT TO SLEEP AND ALL MOST DIED BUT WHEN HE WOKE UP AND HE WAS ON A ILAND AND HE LOOK AROUND AND SEEN A DOLPHIN BUT MICHAEL KEEP SAYING WHO SAVED HIM THEN HE KNOW WHO SAVE HIM THE DOLPHIN AND HE LIVED THE REST OF HIS LIFE ON THE ILAND WITH THE DOLPHIN

THE' END.

Keywords: /peter/boat/boy/

In this piece, Peter adopted a TV-announcer role, a strategy which he had used in the past. There seem to be two plausible purposes for Peter's piece. One is his way of coming to terms with running away. He may also have seen it as a message to his teacher asking for help or understanding. Peter eventually became one of the most prolific writers in the class. In his classroom, girls dominated the keyboard; yet Peter always made sure he had writing time. Late in the year, he became the food editor of the class newspaper and wrote a book five typed pages in length.

Student Lesson #2: Revision is both possible and desirable.

According to some, the computer's most important contribution is that it "takes the sting out of revision"

(Romick, 1984). Professional writers recognize the importance of revision, but the writing process in schools often fails to reflect this. Few teachers give their students the opportunity to revise, and those who do usually face a chorus of moans from their students who hate "copying over." The students rarely understand all that revision can entail, perhaps because of their long exposure to a focus on mechanics and neatness (Scardamalia, 1981). While the presence of a text-editor doesn't guarantee informed revision, it does make it possible without the undue hardship which results from rewriting entire texts.

Some students, in fact, carry revision to extremes. One sixth-grade girl in Hartford was fascinated by the fact that she could potentially produce a perfect paper. While she had been one of the most prolific writers in the class, she was slowed down considerably by her habit of correcting every typo as she noticed it, rather than waiting until she had completed a chunk of text. However, her meticulousness illustrated her real concern with the appearance of her writing.

Most teachers who used QUILL were not accustomed to commenting on the content of students' writing; their training and the demands of achievement tests had encouraged them to focus on mechanics. The training they received during workshops on QUILL, combined with the possibility of their students making substantial changes easily using QUILL, led some of them to respond more substantively to their students' writing. The

result of such feedback can be seen in changes across two drafts of a "New Jersey resolution" written by two fourth-grade boys; the assignment was to develop a resolution which the legislature could pass to help improve New Jersey.

Drugs Are Dumb

Benjamin M. Darren S.

What is bothering us the most in New Jersey is underaged kids are taking drugs. Their not getting enough education. Some kids even get killed! Adults should educate their children not to take drugs. To get help you should go to a psyciatrist. Try not to take drugs. It would take a few months or weeks to get over this problem. It is important to solve this problem. It is important to solve this problem because sometimes people get killed.

Keywords: /psychiatrist/drugs/children/killed/education/

Their conversation with their teacher about this piece focused on the need for snappy conclusions and on how long it would really take to kick a drug habit. Benjamin and Darren then produced the following final draft.

Dangerous Damaging Drugs

Benjamin M. Darren S.

What is bothering us the most in New Jersey is underaged kids are taking drugs. They're not getting enough education. Some kids even get killed! Adults should educate their children not to take drugs or not to get involved with drugs. To get help you should go to a psychiatrist. Try not to take drugs. If you take drugs, go for help! It would take an unlimited amount of time to get over this problem. It is important to solve this problem because sometimes people get killed. So be smart, make sure you don't take drugs!

Keywoods: /psychiatrist/drugs/children/killed/education/

In addition to correcting mechanical errors and responding to their teacher's comments, the two boys revised their previous title, extending the alliterative theme, and increasing the chances for it to attract a reader's attention. This use of the text-editor for both revision and editing within a number of drafts is an important step beyond the way writing instruction is handled in many classrooms.

Lessons for Teachers

Teacher Lesson #1: Truly communicative writing in school is possible, legitimate, and necessary.

Teachers sometimes suppress the most truly communicative form of writing in school, the passing of notes, in favor of more

formal writing which, in fact, is not treated by students or teacher as real communication. One goal of the QUILL project was to convince teachers that assessing the communicative value of any written piece should be a primary concern. In many classrooms, sending messages on Mailbag was used as a beginning activity to acquaint both students and teachers with QUILL. A sixth-grade teacher in Oregon discovered that his students took advantage of this opportunity to write him serious notes about their opinions of school. Some typical examples are: "I think it's a good idea to write our schedule for the day on the board." and "I'd like to do more art in school."

A teacher in a combined sixth, seventh and eighth grade class in Holy Cross, Alaska, took advantage of a real-world situation to create a truly communicative task for her class. Villages in Alaska like Holy Cross (population: 275) receive an inordinate number of requests for information about their village. In Holy Cross, the City Council gives all such requests to the school. After answering several of the letters individually, this teacher decided to have her class construct a tourism brochure about Holy Cross. The project occupied several weeks' time for half a dozen students. They decided what the brochure should include, took responsibility for various sections, did the required research, and wrote the text. The finished product includes several hand-done drawings as well as sections on

schools, clothes, trapping and hunting, fishing, businesses, government, communication, recreation, and population.

A third way teachers discovered to include functional writing in school was through class newspapers. Since the computer is a useful aid for the most onerous parts of putting together a newspaper--text preparation, editing and formatting--many classes published regular editions, as often as monthly. Without the advantage of the computer, the typical pattern one finds is that one or two issues are published, with the bulk of the preparation done by the teacher. The issues end when the teacher gets tired of staying up all night typing dittos. Newspapers in QUILL classrooms were produced for both in-school and out-of-school audiences; the assumed readership included the members of the class, friends, and their families. A newspaper produced by a sixth-grade class in Massachusetts included the following column, editorial in nature and clearly directed to other class members.

Kids' Behavior Toward Substitute Teachers

> When we have a substitute teacher you are suppose to treat them like your own teacher. Some of the kids in the classroom don't treat the substitute teacher with respect. They treat them like another kid. They call the substitute names, or yell out disturbing the teacher. Some of the girls act like it is their

regular teacher, but some of them act fresh. You hardly ever see a boy act nice to the substitute teacher. They always for some reason act nice to to our regular teacher, but not to substitute teachers.

These writing activities demonstrate not only the possibility and legitimacy of communicative writing in the classroom, but its necessity. Students contributed enthusiastically to the newspaper and brochure projects in part because they knew there was a real audience for the information they possessed. This crucial element had been missing in many other less successful classroom writing activities.

Teacher Lesson #2: Changes in the classroom social structure which allow more student interaction can lead to better writing.

One of the unsuspected advantages of having only one computer per classroom is that teachers immediately acknowledge the need for students to work at the computer in pairs or small groups. In most classes, individual work during writing is the rule; with QUILL it has become the exception. The need to have students work on the computer together has led several teachers to realize the potential benefit of collaborative work. A sixth-grade teacher from Oregon commented that papers produced by pairs of students have fewer grammatical errors; he hypothesized that both students' independent writing would also improve as a result of working with another student. The following conversation observed in another sixth-grade class, illustrates one benefit of

student collaboration. The first student had written in a message to students in other cities using the Supermail disk: "We are in Mr. Kinder's class." His partner immediately reminded him that "the kids who read that won't know who Mr. Kinder is!"

One of the most dramatic examples of the influence of social structure on writing occurred in a sixth-grade classroom in Hartford. Students had seen a Black History Show given by the younger classes in the school. Upon returning to their room, several students opted to write reviews of the show. Once they had completed a draft at their desks, students were assigned consecutive numbers which designated their turn to enter their draft on the computer. A backlog soon developed, and several students ended up standing around the computer, reading each other's first drafts. One girl, named Margaret, had written a lukewarm review of the show. Part of her piece read:

> The scenery was pretty good, and the light was bright enough, but the sound was not that good. Mr. Hodges was speaking very loudly and was good on the stage. I think the show deserves three stars because it was very good.

While she was waiting to use the computer, Margaret read a first draft by her friend, Marines. Marines' review claimed that the "the light was a little dull." She also complained about the Glee Club: "They were almost all weak. The audience couldn't

hear them. They sounded soft then they went loud. It was a disaster!"

Margaret was aware that her review and Marines' expressed different opinions--and that hers might be ignored in the face of Marines' strong views. But she also had an explanation for Marines' criticism of the Glee Club. This explanation was included in her final draft.

> The scenery wasn't very much, and the light was kind of dull, and the sound wasn't very good. Mr. Hodges was speaking loud and clearly, and he was great on the stage. When the Glee Club was singing so nice, Marines got very jealous and asked Mrs. Evens to be in the Glee Club. But when Mrs. Evens said no she wrote bad things about the Glee Club on the computer upstairs.

Notice that while she had undermined Marines' opinion of the Glee Club, she has also changed her own description of the lighting to agree with the other girl's (see Bruce, Michaels, & Watson-Gegeo, 1985, for a more detailed analysis).

None of these incidents would have occurred in the traditional model of writing instruction--students sitting alone, writing, turning in a paper, and receiving a grade. The presence of QUILL in the classroom contributed to creating a positive context for writing by "shaking up" the teaching of writing,

making it necessary for students to write together in order to have sufficient computer time. The challenge for teachers is to channel these social interactions to improve student's writing.

Lessons for Software Designers

Software Designer Lesson #1: A teacher's instructional philosophy is a more powerful determinant of software use than the software itself; that is, the teacher's contribution overwhelms that of the software.

Many software designers overestimate the effect their software will have on education. At a global scale, predictions are made of revolutions in education and a technologically literate citizenry due largely to the use of new software (Papert, 1980). Our experience has shown that, especially in the case of open-ended software like QUILL, the software makes an important, but not an enormous, contribution to what happens in the classroom. A much more potent effect comes from the teacher.

One example can be found in teacher's use of Mailbag in their classrooms. One of our most successful classrooms, particularly in their use of electronic mail, was a fourth grade class who used the QUILL software in its very early stages. Even using a relatively primitive system, messages flew among the students, and between students and their teacher. The teacher made it clear to her students that she believed this written exchange among the students served an important educational purpose.

In contrast, a teacher in another class later in the project viewed students' use of Mailbag as illegitimate writing once they started using it to write love notes, and immediately made it unavailable. By this time, the Mailbag had been polished and was easier to use, but the teacher clearly indicated to her students that she felt it lacked any educational value.

The process of educational change involving QUILL seemed to proceed in two stages. First, the software made possible a new writing genre (written conversations, in the case of Mailbag). Second, the teacher responded to this new genre in her own way. In the most positive cases, teachers transferred the children's new-found sense of communicative writing to other genres and modalities. In the most negative cases, teachers rejected the new genre as illegitimate.

Teachers demonstrated interesting differences in communicating with students using Mailbag. A sixth-grade teacher in Hartford adopted two separate personae in writing to his students. The first was a perfectly serious one used when he carried on straightforward--and sometimes quite personal--written conversations with his students. The following exchange is typical:

Bathroom

Marlowe B.

There is a lot of trouble in the bathroom. There's been writing on the new paint job, and there's been someone who's been peeling the paint off the radiator. If people keep messing up the bathroom, Ducky said that she was going to close the bathroom until we learn not to write in it. And there's been plenty of noice in there. If we don't have to go to the bathroom, don't go in.

Keywords: /bathroom/clean/

Girl's Bathroom

Dr. A.

Dear Pee Wee,

Thank you for being concerned about the girls' bathroom. I feel sorry for the girls who are messing it up. They must be a little "messed up" themselves. When I see Ducky, I'll try to remember to tell her what you did.

Dr. A.

When he was not being serious, this teacher adopted a frivolous personality called Dunedeen, a mischievous monster who sent anonymous messages to several students each week. These messages, predictably, provoked similar unserious replies. Both

sets of messages were filled with "Hahahaha" and epithets such as "Squarehead." The central point of this story is that students responded in kind to whatever personality the teacher adopted. The teacher was careful to separate the two because they required such different responses from his students.

A fourth-grade teacher in New Jersey used Mailbag quite differently. One of the suggestions in the Teacher's Guide for using Mailbag is "Classroom Chat," an adaptation of the popular newspaper column, "Confidential Chat." By sending anonymous messages students can discuss personal problems with other Chatters in the class without revealing their identity. In the newspaper prototype, writers usually adopt a pseudonym that refers to their problem (e.g., Hassled Mom or Concerned Commuter). This teacher decided to use this idea to give her class an assignment. She sent the following message, complete with pseudonym.

The Shower Problem

I. Needabath

Dear Classy Computer Kids,

There are five members in my family and only one shower. Because I'm the youngest member of our family, I'm the last one in line to take a shower. By then, there's usually no more hot water and not too much time

for me to wash behind my ears! It's a horrible way to start the day. What can I do to solve this problem?

Cold, late, and dirty,

I. Needabath

The assignment produced the following predictably tongue-in-cheek responses, responses which hover between reality and fantasy much as the original letter did.

Buying a Shower

Jill Y. Suzanne H.

Dear Ichabod Needabath,

The next time your parents have a garage sale, go to your room and pick out things you don't use anymore. Put them with the rest of the items that are going to be sold. (Make sure you ask your parents first.) Take the money that you make from the sale and dig deep into your piggy bank for more. Go to your parents and give them your money. Ask them (nicely) if they will buy a shower with the money you have. (Some other family members can use it after you.) If at first they say no, tell them it wil be better for the whole family. Good Luck, Icky!!

Showers

Dear I. Needabath,

I think you should tell the first person that takes a shower you have to go the bathroom. Then they should let you go before they take a shower. Quickly lock the door and take your shower. You will have enough of time to wash behind your ears.

Sneaky and Desperate,

Kerry N. and Jenny B.

An interesting problem emerged in this writing activity: The form of the teacher's letter mimicked that of the standard Confidential Chat letter, but the students in the class all knew who had sent the letter and, even more important, that it posed a fake problem. Thus, their assignment was to pretend they were answering a real letter from a needy person; yet, they knew it was an imaginary letter from their teacher. While students produced imaginative pieces, observers in the classroom reported they were confused about their audience (their teacher or I. Needabath) and their purpose (real or fantasy) while they were writing. This lack of clarity was most obvious when they were signing their names; many were not sure whether to use their own names or to make up pseudonyms.

While the software was identical in our two examples, the outcome was notably different. These differences can be

attributed to the teacher's style and values. QUILL contributed the concept of Mailbag and a medium through which students could send messages, but the content of the writing belonged to the teacher and the students.

Software Designer Lesson #2: There is an important difference between using a computer for text-editing and for communication.

When we began designing QUILL, we underestimated the importance of this distinction. We knew there were text editors available for schools, but we thought they were insufficient. We wanted to create software informed by recent work on the writing process. In fact, one of our early designs required children to access the text editor by declaring the part of the writing process (drafting, revising, editing, etc.) on which they were working. It seemed clear to us that an effective writing curriculum should be embedded in the writing process. A corollary was that a piece of writing software had to embody writing process concepts.

We were suprised, later, to find that the usefulness of QUILL in many classrooms derived not from our (perhaps insufficient) attempts to reflect the writing process but from its ability to support the establishment of environments for communication, e.g., the exchange of personal mail, sharing writing with others, and publishing newspapers. In contrast, we found some classrooms where QUILL's communication environments were not utilized. For example, in one junior high classroom the

teacher did not want to allow direct communication among students since, she feared, it might encourage obscene language. In that case a simple text editor, such as Writer's Assistant, would have been more appropriate.

While QUILL includes a text editor as a tool, it is only part of a larger environment which provides purposes and audiences for writing. For private writing (e.g., diaries) or public writing which is only to be shared in printed form (e.g., professional papers), a text editor might be sufficient. In fact, in that case the environments of QUILL could be cumbersome and interfere with writing. Students in many situations, however, would benefit from more attention to the social aspects of writing. Social environments and interactions with peers and teachers provide a sense of purpose and audience for young writers, especially if they have access to software which can provide support for the processes of drafting, editing, and publishing their work.

Summary

The six lessons presented here arose during two years of field-testing QUILL in second through eighth grade classrooms. During that time we also learned much about the importance of administrative support to the success of educational innovations. Teachers taught us a great many lessons about creative and effective uses of QUILL which we had never imagined. Had we designed a program which required multiple-choice answers or

merely asked students to edit a flawed piece, we would have missed important aspects of the learning process. The final lesson for software designers is just this: we will all learn more if the software is flexible and adaptable. The software should contain fewer computer-oriented terms. This lesson applies to other educational contexts as well. QUILL's open-ended nature and attention to process provided a context in which both students and teachers increased their awareness of literacy. Similarly, other flexible contexts for language instruction can lead to significant and truly individualized learning for all the participants.

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